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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/730,335	12/04/2000	Charles H. Dennison	MI22-1577	8465

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WELLS ST. JOHN ROBERTS GREGORY & MATKIN P.S.
601 W. FIRST AVENUE
SUITE 1300
SPOKANE, WA 99201-3828

EXAMINER

NADAV, ORI

ART UNIT	PAPER NUMBER
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2811

DATE MAILED: 12/27/2002

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/730,335

Applicant(s)

DENNISON, CHARLES H.

Examiner

ori nadav

Art Unit

2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03 September 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 57-75 and 78-92 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 57-61 is/are allowed.
- 6) ☒ Claim(s) 62-75, 78-81, 85 and 89 is/are rejected.
- 7) ☒ Claim(s) 82-84, 86-88 and 90-92 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

Art Unit: 2811

DETAILED ACTION

Drawings

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, two barrier layers, as recited in claim 57, and a gate consisting of conductively doped semiconductor material of the first type and a conductive diffusion barrier layer, as recited in claim 85, must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Objections

2. Claim 62 recites the limitation "the gate semiconductive material" in lines 12-13. There is insufficient antecedent basis for this limitation in the claim.

Art Unit: 2811

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 62-64, 67-68, 70-71, 80-81, 85 and 89 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pfister (4,997,785) in view of Wu (5,710,454) and Hachiya (5,244,835) or Dennison (5,637,525).

Pfister teaches in figure 7 and related text an Integrated circuitry comprising: a field effect transistor including a gate, a gate dielectric layer, source/drain regions 24, 26 and a channel region; the gate comprising semiconductive material 16 conductively doped with a conductivity enhancing impurity of a first type N⁺ and a conductive diffusion barrier layer 30 effective to restrict diffusion of first or second type conductivity enhancing impurity, wherein the semiconductive material within the insulating material contacts the conductive diffusion barrier layer of the gate, and wherein the conductive diffusion barrier layer is received over the gate semiconductive material, and the semiconductive material within the insulating material is received over the gate..

Pfister does not teach a contact structure extending through the insulative material to the gate, wherein the contact structure including a semiconductive material provided through the insulative material being conductively doped with a conductivity enhancing

Art Unit: 2811

impurity of a second type P+, such that the conductive diffusion barrier layer of the gate being provided between the gate semiconductive material and the semiconductive material provided through the insulative material. That is, Pfister does not teach a contact structure including a semiconductive material provided through insulative material 44 being conductively doped with a conductivity enhancing impurity of a second type P+ and making contact to layer 20 having a conductivity enhancing impurity of a second type P+.

Wu teaches in figure 3 and related text a contact structure extending through insulative material 22a to the gate, wherein the contact structure including a semiconductive material provided through the insulative material being conductively doped with a conductivity enhancing impurity of a conductivity type, such that the conductive diffusion barrier layer of the gate being provided between the gate semiconductive material and the semiconductive material provided through the insulative material, the insulative material comprises an opening substantially void of any conductive diffusion barrier layer material. wherein neither of the contact structure sidewalls aligning with either of the opposing sidewalls of the gate in one cross section (column 10, lines 51-58).

Hachiya teaches in figure 4 a contact structure 16N including a semiconductive material being conductively doped with a conductivity enhancing impurity of a first N+ type making contact to a region of a semiconductive material being conductively doped

Art Unit: 2811

with a conductivity enhancing impurity of a first N+ type, and a contact structure 17P including a semiconductive material being conductively doped with a conductivity enhancing impurity of a second P+ type making contact to a region of a semiconductive material being conductively doped with a conductivity enhancing impurity of a second P+ type.

Dennison teaches in figure 11 a contact structure 54 including a semiconductive material being conductively doped with a conductivity enhancing impurity of a first N+ type making contact to a region 56 of a semiconductive material being conductively doped with a conductivity enhancing impurity of a first N+ type, and a contact structure 40 including a semiconductive material being conductively doped with a conductivity enhancing impurity of a second P+ type making contact to a region 42 of a semiconductive material being conductively doped with a conductivity enhancing impurity of a second P+ type.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a contact structure extending through the insulative material to the gate, wherein the contact structure including a semiconductive material provided through the insulative material being conductively doped with a conductivity enhancing impurity, as taught by Wu, of a second type P+, as taught by Hachiya and Dennison, such that the conductive diffusion barrier layer of the gate being provided between the gate semiconductive material and the semiconductive material provided through the

Art Unit: 2811

insulative material in Pfiester's device, in order to operate the device by providing external connections to the gate, and in order to simplify the processing steps of making the device and to reduce the contact resistance and the device characteristics, respectively. The combination is motivated by the teachings of Pfiester who points out that the device can be used in an application which requires a contact structure contacting the gate, and by the teachings of Hachiya and Dennison who point out the advantages of using a contact structure of one conductivity type to make contact to a region of the same conductivity type.

Regarding claim 64, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a first type p and a second type n in Pfiester's device, in order to use the device in an application which requires electrical contact to the NMOS.

Regarding claim 68, the semiconductive material within the insulating material of prior art's device does not contact the conductive diffusion barrier layer of the gate.

Regarding claim 85, Pfiester teaches in figure 7 one gate electrode consists of a conductivity doped semiconductive material of the first type 16 and a conductive diffusion barrier layer 30.

Art Unit: 2811

Regarding claim 89, Pfiester teaches in figure 7 a gate electrode can alternatively consist of a conductivity doped semiconductive material of the first type 16, a conductive diffusion barrier layer 30 and a conductive silicide 20.

5. Claims 65, 66, 69, 72, 74 and 78 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pfiester, Wu, Hachiya and Dennison, as applied to claim 62 above, and further in view of Ku (5,856,237).

Regarding claim 65, Pfiester, Wu, Hachiya and Dennison teach substantially the entire claimed structure, as applied to claim 62 above, except a gate also comprises a conductive silicide.

Ku teaches in figure 4F a gate comprises a conductive diffusion barrier layer 140 selected from the group consisting of W_xN_y , TiO_xN_y , and TiW_xN_y , and mixtures thereof over a conductive silicide 124 comprising $TiSi$.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a gate also comprises a conductive silicide in prior art's device, in order to reduce the contact resistance of the gate.

Regarding claim 66, the silicide and the conductive diffusion barrier layer comprise the same material, Titanium.

Art Unit: 2811

6. Claim 73 is rejected under 35 U.S.C. 103(a) as being unpatentable over Pfiester, Wu, Hachiya, Dennison and Ku, as applied to claim 72 above, and further in view of Chow et al. (4,847,111) and Charneski et al. (5,909,637)..

Pfiester, Wu, Hachiya, Dennison and Ku teach substantially the entire claimed structure, as applied to claim 72 above, except a conductive diffusion barrier layer comprising WxNy.

Chow et al. teach in figure 1c a conductive diffusion barrier layer comprising WxNy.

Charneski et al. teach a conductive diffusion barrier layer comprising WxNy, TiOxNy, TiN and TiWxNy (column 10, lines 20-22).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a conductive diffusion barrier layer comprising WxNy in prior art's device, in order to prevent diffusion and to strengthen the adhesion, and because TiOxNy, TiN and WxNy are conventional interchangeable materials used as conductive barrier diffusion layers in a gate electrode. Note that substitution of materials is not patentable even when the substitution is new and useful. *Safetran Systems Corp. v. Federal Sign & Signal Corp.* (DC NIII, 1981) 215 USPQ 979.

Art Unit: 2811

7. Claim 75 is rejected under 35 U.S.C. 103(a) as being unpatentable over Pfiester, Wu, Hachiya, Dennison and Ku, as applied to claim 72 above, and further in view of Igarashi and Charneski et al. (5,909,637)..

Pfiester, Wu, Hachiya, Dennison and Ku teach substantially the entire claimed structure, as applied to claim 72 above, except a conductive diffusion barrier layer comprising TiWxNy.

Igarashi teaches a gate electrode comprising TiN or TiWxNy (column 4, lines 4-9).

Charneski et al. teach a conductive diffusion barrier layer comprising WxNy, TiOxNy, TiN and TiWxNy (column 10, lines 20-22).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a conductive diffusion barrier layer comprising TiWxNy in prior art's device, in order to prevent diffusion and to strengthen the adhesion, and because TiOxNy, TiN and TiWxNy are conventional interchangeable materials used as conductive barrier diffusion layers in a gate electrode. Note that substitution of materials is not patentable even when the substitution is new and useful. *Safetran Systems Corp. v. Federal Sign & Signal Corp.* (DC NIII, 1981) 215 USPQ 979.

8. Claims 65 and 79 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pfiester, Wu, Hachiya and Dennison, as applied to claim 62 above, and further in view of Bai et al. (5,818,092).

Art Unit: 2811

Pfiester, Wu, Hachiya and Dennison teach substantially the entire claimed structure, as applied to claim 62 above, except a gate also comprises a conductive silicide over a conductive diffusion barrier layer.

Bai et al. teach in figure 2C a conductive silicide 220 over a conductive diffusion barrier layer 206.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a gate also comprises a conductive silicide over a conductive diffusion barrier layer in prior art's device, in order to reduce the contact resistance of the gate.

Allowable Subject Matter

9. Claims 57-61 are allowed.

10. Claims 82-84, 86-88 and 90-92 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Reasons for allowance

Art Unit: 2811

11. The following is an examiner's statement of reasons for allowance: Prior art does not teach a conductive diffusion barrier layer comprising $WxNy$ and $TiWxNy$, and a conductive diffusion barrier layer comprising $TiOxNy$ and $TiWxNy$

Response to Arguments

12. Applicant argues that Hachiya and Dennison teach a contact structure doped with a conductivity of a second type making contact to a region of a semiconductive material being doped with a conductivity the second type, and none of the references teach a contact structure doped with a conductivity of a first type making contact to a region of a semiconductive material being doped with a conductivity the second type, as claimed.

Pfiester teaches a gate electrode comprising a gate semiconductive material of the first type N+ 16 and a semiconductive material of the second type P+ 20. Pfiester's structure would meet the claimed limitations which call for a contact structure of the second type P+ and a gate semiconductive material of the first type N+ 16 if a contact structure of the second type P+ is formed therein. A contact structure of the second type in Pfiester's device would contact the semiconductive material of the second type P+ 20. Therefore, an artisan would require a reference teaching a contact structure of the second type P+ making contact to a gate semiconductive material of the second

Art Unit: 2811

type P+ 20. Hachiya and Dennison teach a contact structure doped with a conductivity of a second type making contact to a region of a semiconductive material being doped with a conductivity the second type, as required.

Papers related to this application may be submitted to Technology center (TC) 2800 by facsimile transmission. Papers should be faxed to TC 2800 via the TC 2800 Fax center located in Crystal Plaza 4, room 4-C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (November 15, 1989). The Group 2811 Fax Center number is (703) 308-7722 and 308-7724. The Group 2811 Fax Center is to be used only for papers related to Group 2811 applications.

Any inquiry concerning this communication or any earlier communication from the Examiner should be directed to *Examiner Nadav* whose telephone number is **(703) 308-8138**. The Examiner is in the Office generally between the hours of 7 AM to 4 PM (Eastern Standard Time) Monday through Friday. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas, can be reached at **(703) 308-2772**.

Art Unit: 2811

Any inquiry of a general nature or relating to the status of this application should be directed to the **Technology Center Receptionists** whose telephone number is **308-0956**

A handwritten signature in black ink, appearing to read 'Ori Nadav', with a stylized, cursive script.

O.N.
December 23, 2002

ORI NADAV
PATENT EXAMINER
TECHNOLOGY CENTER 2800